APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/301,961	04/29/1999	ANTHONY P. PEIRCE	56.468	6283

27452   7590   02/26/2003

SCHLUMBERGER TECHNOLOGY CORPORATION
IP DEPT., WELL STIMULATION
110 SCHLUMBERGER DRIVE, MD1
SUGAR LAND, TX 77478

EXAMINER
DAY, HERNG DER

ART UNIT	PAPER NUMBER
2123	

DATE MAILED: 02/26/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 07-01)

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-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) FROM
THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed
  after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any
  earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 April 1999* .

2a)☐ This action is **FINAL**.   2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is
closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *29 April 1999* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

    If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☐ All b)☐ Some * c)☐ None of:

        1.☐ Certified copies of the priority documents have been received.

        2.☐ Certified copies of the priority documents have been received in Application No. _____ .

        3.☐ Copies of the certified copies of the priority documents have been received in this National Stage
application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

    a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)   4)☐ Interview Summary (PTO-413) Paper No(s). _____ .

2) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)   5)☐ Notice of Informal Patent Application (PTO-152)

3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *2* .   6)☐ Other: .

DETAILED ACTION

1. Claims 1-20 have been examined and claims 1-20 have been rejected.

Information Disclosure Statement

2. The information disclosure statement filed April 29, 1999, fails to comply with the provisions of 37 CFR 1.97, 1.98 and MPEP § 609 because publication date has not been provided for references CB, CD, and CF. References CB, CD, and CF have been considered and placed in the application file but will not be made of record due to the omission of the date.

3. The Examiner requests detailed information about the FracCADE package referred to in the specification and drawings, including the application of a mesh of elements and the element updating algorithm, because it appears to be reasonably necessary to the examination of this application and cannot be located.

As described in page 2 of the reference document CC submitted with the information disclosure statement, "FracCADE's technology can help you with simple reservoirs and more complex isolated multiple-layer reservoirs" has been disclosed in section "The Power to Design". Also disclosed in page 1 is that FracCADE will "Use the pseudo three-dimensional (P3D) hydraulic fracturing simulator". It appears that the FracCADE discloses the simulation of a multiple-layer reservoir. However, in page 3, lines 10-20, of the specification, Applicants argue that the P3D method cannot accurately represent fracture geometry in more complex treatments that involve multiple geological layers underground. It is also noted that the FracCADE package is used to input data and output results as shown in FIG. 18 to FIG. 20.

Drawings

4.   The drawings are objected to for the following reasons. A proposed drawing correction

or corrected drawings are required in reply to the Office action to avoid abandonment of the

application. The objection to the drawings will not be held in abeyance.

4-1.   The Draftsperson has objected to the drawings; see the copy of Form PTO 948 for an

explanation.

4-2.   The drawing of FIG. 20 is objected to as failing to provide the title or description

explaining those values on Y-axis.

Specification

5.   The disclosure is objected to because of the following informalities:

Appropriate correction is required.

5-1.   It appears that "determines the Fourier Transforms of displacement components u_x, u_y,

and u_z", as described in lines 20-21 of page 23, should be "determines the Fourier Transforms of

displacement components $\hat{u}_x$, $\hat{u}_y$, and $\hat{u}_z$".

Claim Rejections - 35 USC § 112

6.   The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making
> and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it
> pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode
> contemplated by the inventor of carrying out his invention.

7.   Claims 1-20 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

First, a detailed description has not been provided for some of the variables shown in the equations. For example, it is unclear for one skilled in the art what the exact meaning is for $\sigma_{ij,j}$, what the ranges are for i and j as shown in equation (1), and what is the difference between $\sigma_{ij,j}$ and σ_{ij} as shown in equation (2).

Next, as described in lines 4-6 of page 25, "the α_j are the roots of the characteristic equation for the system of ordinary differential equations", however, it is unclear for one skilled in the art why α_j is layer independent while all other variables are layer dependent in a multiplayer environment as shown in equations (6) – (9). Nevertheless, for the inversion process as shown in equation (12), α_j^l is layer dependent as well as all other variables.

Then, as described in lines 6-8 of page 25, "the $A_j^l(k)$ are free parameters of the solution that are determined by the forcing terms b_j in (1)", however, b_j does not exist in (1). Therefore, it is unclear for one skilled in the art whether equation (1) is still valid.

Also, as described in lines 6-10 of page 7, "the first data set comprising at least one of the following: time history of fluid volumes, time history of proppant volumes, fluid properties, proppant properties, and geological properties". When the first data set comprising only the data of, for example, time history of fluid volumes, and no data about any properties, it satisfied the "at least one" requirement. However, it is unclear for one skilled in the art how to determine

dimensions of a hydraulic fracture by values computed by manipulating only the data of "time

history of fluid volumes" using equations comprising hydraulic fracturing relationships.

Also, consider, for example, claim 8. The claim recites a method for monitoring or

evaluating the fracture of a well in real time. However, as described in lines 12-13 of page 32,

"such a process would likely exclude the possibility of real time processing". Therefore, it is

unclear for one skilled in the art how to monitor or evaluate the fracture of a well in real time

with a process would likely exclude the possibility of real time processing.

In view of the unclear meaning for some of the variables shown in the equations,

inconsistent application of the roots of the characteristic equation for the system of ordinary

differential equations, and a limited data set, it has been determined claims 1-20 contain subject

matter which was not described in the specification in such a way as to enable one skilled in the

art to which it pertains, or with which it is most nearly connected, to make and/or use the

invention.

8.   The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the
> subject matter which the applicant regards as his invention.

9.   Claims 3 and 11 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite

for failing to particularly point out and distinctly claim the subject matter which applicant

regards as the invention.

9-1.   Claim 3 recites the limitation "the elements" in the first line of the claim. There is

insufficient antecedent basis for this limitation in the claim. Also note, claim 3 recites the

limitation "in some cases" in lines 1-2 of the claim. It is vague and indefinite about "in some

cases" because "some cases" have not been disclosed completely.

9-2. The term "minimal" in claim 11 is a relative term that renders the claim indefinite. The term "using minimal computing power" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

Claim Rejections - 35 USC § 102

10. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

11. Claims 1, 2, 5, and 20 are rejected under 35 U.S.C. 102(b) as being anticipated by "GOHFER Grid Oriented Hydraulic Fracture Extension Replicator", Stim-Lab, Inc. and Marathon Oil Company, 1996 (reference document CA, submitted with the information disclosure statement on April 29, 1999, referred to as GOHFER).

11-1. Regarding claim 1, GOHFER discloses a device comprising means for storing instructions, said instructions adapted to be executed by a processor of a computer, said instructions when executed by the processor executing a process comprising the steps of:

(a) obtaining a first data set, the first data set comprising at least one of the following: time history of fluid volumes (fluid volume, appendix I, page 3), time history of proppant volumes (proppant conc and fluid volume, appendix I, page 3), fluid properties (fluid properties, appendix I, page 3), proppant properties (proppant properties, appendix I, page 3), and geological properties (formation properties, appendix I, page 2),

(b) providing the first data set to a computer, the computer having a processor capable of

executing instructions (processor, section 1.1, page 4) the computer further having electronic

storage means (RAM and hard disk, section 1.1, page 4) with stored equations comprising

hydraulic fracturing relationships (model, section 4.2.2, page 28),

(c) computing by said processor a first set of values by manipulating said first data set

using said stored equations (Executing, Chapter 4, pages 28-30),

(d) determining from said first set of values dimensions of a hydraulic fracture, the

dimensions including fracture height and length, fracture width (Fracture Size vs. Time,

appendix I, page 7) and fluid pressures (Pressure vs. Time, appendix I, page 5) as a function of

time,

(e) converting said first set of values into a set of output data, the output data representing

fracture dimensions (Fracture Size vs. Time, appendix I, page 7) and pressures (Pressure vs.

Time, appendix I, page 5) as a function of pumping time,

(f) displaying the output data on a computer monitor (WinParse can be used as a run-time

monitor, section 5, pages 31-43).

11-2.   Regarding claim 2, GOHFER further discloses that the step of determining from said first

set of values dimensions of a hydraulic fracture is achieved using a mesh of elements (GOHFER

is a grid based model, section 3.4, pages 13-15).

11-3.   Regarding claim 5, GOHFER further discloses that the elements are segregated into

subterranean geological layers such that stresses and strains corresponding to respective elements

within a given subterranean geological layer will be represented in the output data (stress and

strain, section 3.5.7.1-3.5.7.8).

11-4. Regarding claim 20, GOHFER discloses a data processing system for managing and

observing the variables used in fracturing of a subterranean formation, comprising:

(a) computer processor means for processing data (processor, section 1.1, page 4);

(b) storage means for storing data on a storage medium (RAM and hard disk, section 1.1,

page 4);

(c) first means for initializing the storage medium (New Project, section 3.7.1.1, page

23);

(d) second means for processing data regarding fracturing fluid time histories, fluid

volumes, fluid properties (Pumping Schedule, section 3.6, pages 22-23), and geological

properties (Rock Properties, section 3.5, pages 15-21);

(e) third means for processing data using equations having established known

mathematical relationships into a first set of values (Executing, Chapter 4, pages 28-30);

(f) fourth means for converting said first set of values into a set of output data (reporting

Functions, section 5.4, pages 35-40); and

(g) fifth means for displaying, printing, said output data (can be viewed on the screen and

sent to the printer, section 5.4.5, page 39).

Claim Rejections - 35 USC § 103

12.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in
> section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are
> such that the subject matter as a whole would have been obvious at the time the invention was made to a person
> having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the
> manner in which the invention was made.

13.   Claims 13-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over "GOHFER

Grid Oriented Hydraulic Fracture Extension Replicator", Stim-Lab, Inc. and Marathon Oil

Company, 1996 (reference document CA, submitted with the information disclosure statement

on April 29, 1999, referred to as GOHFER), in view of Linkov et al., "An Effective Method for

Multi-Layered Media with Cracks and Cavities", International Journal of Damage Mechanics,

Vol. 3, October 1994, pages 338-356 (reference document CO, submitted with the information

disclosure statement on April 29, 1999).

13-1.   Regarding claim 13, GOHFER discloses a method comprising:

        (a) obtaining a first data set (properties, etc., appendix I, pages 2-3),

        (b) providing the first data set to a computer, the computer having a processor capable of

executing instructions, the computer further having electronic storage means (RAM and hard

disk, section 1.1, page 4) with stored equations comprising hydraulic fracturing relationships

(model, section 4.2.2, page 28),

        (c) computing by said processor a first set of values by manipulating said first data set

using said stored equations (Executing, Chapter 4, pages 28-30),

        (d) determining the dimensions of a hydraulic fracture using a mesh of elements

(GOHFER is a grid based model, section 3.4, pages 13-15),

        (e) converting said first set of values into a set of output data, the output data representing

fracture dimensions (Fracture Size vs. Time, appendix I, page 7) and pressures (Pressure vs.

Time, appendix I, page 5) as a function of pumping time.

However, GOHFER fails to disclose expressly that (1) the hydraulic fracturing relationships comprising a Fourier Transform solution of multilayer equilibrium equations, (2) the solution employing at least one inversion process, and (3) the equations including a Green's function.

Linkov et al. propose an efficient method to solve problems for elastic multi-layered media with cracks, which arise in rock mechanics, using the Green function by means of Fourier transform and sweep-method. Having the Green function, one reduces the problem for damaged layers to solution of integral equation which is defined only on surfaces of cracks and can be solved by conventional boundary element method (abstract, page 338). Specifically, Linkov et al. disclose:

(b) the hydraulic fracturing relationships comprising a Fourier Transform solution of multilayer equilibrium equations (Fourier Transform can be effectively employed to solve the typical problems, page 346), the solution employing at least one inversion process (Inverse transforms, page 346);

(c) the equations including a Green's function (use of the Green function, abstract, page 338).

Linkov et al. disclose that problems for elastic multi-layered media with cracks arise in rock mechanics (abstract, page 338). In order to do the hydraulic fracturing analysis and design one of ordinary skill in the art would be motivated to solve these problems of elastic multi-layered media, in addition to single-layered media, with cracks because they do arise in rock mechanics.

Accordingly, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of GOHFER to incorporate the teachings of Linkov et al. to obtain the invention as specified in claim 13 because by using Green function and Fourier transform, Linkov et al. disclose an efficient method to reduce the multi-layered problem and solve it by conventional boundary element method.

13-2. Regarding claim 14, GOHFER further discloses:

(f) displaying the data for a user (The View Graph function allows WinParse to become a run-time monitor, section 5.7, page 43).

13-3. Regarding claim 15, GOHFER further discloses:

(f) sending the data to a remote site by way of a transmission medium (a networking environment, section 1.1.3, page 4).

13-4. Regarding claim 16, GOHFER further discloses:

(f) printing the output data (The Report button generates a report that can be viewed on the screen and sent to the printer, section 5.4.5, page 39).

13-5. Regarding claim 17, it is a device claim including equivalent method limitation as recited in claim 13, and is rejected based on the same reasoning of claim 13.

13-6. Regarding claim 18, GOHFER further discloses that said pre-recorded means is selected from the group of magnetic tape, a magnetic disk, an optical disk, a CD-ROM (hard disk, section 1.1, page 4).

13-7. Regarding claim 19, GOHFER discloses a report generated by illustrating a characteristic or set of values for a fracturing operation of a formation penetrated by a wellbore, said formation having a reservoir of oil or gas, comprising the steps of:

(a) obtaining a first data set (properties, etc., appendix I, pages 2-3),

(b) providing the first data set to a computer, the computer having a processor capable of

executing instructions, the computer further having pre-recorded means (hard disk, section 1.1,

page 4) with stored equations comprising hydraulic fracturing relationships (model, section

4.2.2, page 28),

(c) computing by said processor a first set of values by manipulating said first data set

using said stored equations (Executing, Chapter 4, pages 28-30),

(d) determining the dimensions of a hydraulic fracture using a mesh of elements

(GOHFER is a grid based model, section 3.4, pages 13-15),

(e) converting said first set of values into a set of output data, the output data representing

fracture dimensions (Fracture Size vs. Time, appendix I, page 7) and pressures (Pressure vs.

Time, appendix I, page 5) as a function of pumping time, and

(f) generating a report (The Report button generates a report, section 5.4.5, page 39).

However, GOHFER fails to disclose expressly that (1) the hydraulic fracturing

relationships comprising a Fourier Transform solution of multilayer equilibrium equations, (2)

the solution employing at least one inversion process, (3) the equations including a Green's

function.

Linkov et al. propose an efficient method to solve problems for elastic multi-layered

media with cracks, which arise in rock mechanics, using the Green function by means of Fourier

transform and sweep-method. Having the Green function, one reduces the problem for damaged

layers to solution of integral equation which is defined only on surfaces of cracks and can be

solved by conventional boundary element method (abstract, page 338). Specifically, Linkov et al. disclose:

(b) the hydraulic fracturing relationships comprising a Fourier Transform solution of multilayer equilibrium equations (Fourier Transform can be effectively employed to solve the typical problems, page 346), the solution employing at least one inversion process (Inverse transforms, page 346);

(c) the equations including a Green's function (use of the Green function, abstract, page 338).

Linkov et al. disclose that problems for elastic multi-layered media with cracks arise in rock mechanics (abstract, page 338). In order to do the hydraulic fracturing analysis and design one of ordinary skill in the art would be motivated to solve these problems of elastic multi-layered media, in addition to single-layered media, with cracks because they do arise in rock mechanics.

Accordingly, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of GOHFER to incorporate the teachings of Linkov et al. to obtain the invention as specified in claim 19 because by using Green function and Fourier transform, Linkov et al. disclose an efficient method to reduce the multi-layered problem and solve it by conventional boundary element method.

Allowable Subject Matter

14.   Claims 6-12 are deemed novel and non-obvious over the prior art of record, and would be

allowed once the above rejections under 35 U.S.C. 112, first and second paragraphs are

overcome.

Dependent claims 3 and 4 would be allowable if rewritten to overcome the rejections

under 35 U.S.C. 112, first and second paragraph, set forth in this Office action and rewritten in

independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

15.   The prior art made of record and not relied upon is considered pertinent to applicant's

disclosure.

Reference to Soliman, U.S. Patent 4,828,028 issued May 9, 1989, is cited as disclosing a

method for performing fracturing operations.

Reference to Widrow, U.S. Patent 4,858,130 issued August 15, 1989, is cited as

disclosing an estimation of hydraulic fracture geometry from pumping pressure measurements.

Reference to Poulsen, U.S. Patent 5,070,457 issued December 3, 1991, is cited as

disclosing methods for design and analysis of subterranean fractures using net pressures.

Reference to Scott, III, U.S. Patent 5,413,179 issued May 9, 1995, is cited as disclosing

system and method for monitoring fracture growth during hydraulic fracture treatment.

Reference to Cacas, U.S. Patent 5,659,135 issued August 19, 1997, is cited as disclosing

a method for modeling a stratified and fractured geologic environment.

Reference to Cacas, U.S. Patent 5,661,698 issued August 26, 1997, is cited as disclosing

a method for modeling the spatial distribution of geometric objects in an environment, such as

faults in a geologic formation.

Reference to Withers et al., U.S. Patent 5,771,170 issued June 23, 1998, is cited as

disclosing system and program for locating seismic events during earth fracture propagation.

Reference to Vasudevan et al., U.S. Patent 6,076,046 issued June 13, 2000, and filed July

24, 1998, is cited as disclosing post-closure analysis in hydraulic fracturing.
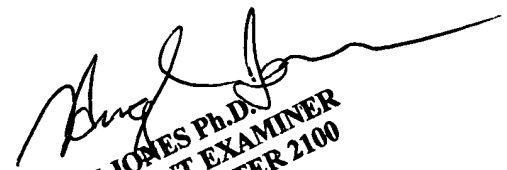
Reference to Hocking et al., U.S. Patent 6,216,783 issued April 17, 2001, and filed

November 17, 1998, is cited as disclosing a method for initiating an azimuth controlled vertical

hydraulic fracture.

16.   Any inquiry concerning this communication or earlier communications from the

examiner should be directed to Herng-der Day whose telephone number is (703) 305-5269. The

examiner can normally be reached on 8:30 - 17:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's

supervisor, Kevin J Teska can be reached on (703) 305-9704. The fax phone numbers for the

organization where this application or proceeding is assigned are (703) 746-7239 for regular

communications and (703) 746-7238 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding

should be directed to the receptionist whose telephone number is (703) 305-3900.

Herng-der Day
February 7, 2003

HUGH JONES Ph.D.
PRIMARY PATENT EXAMINER
TECHNOLOGY CENTER 2100